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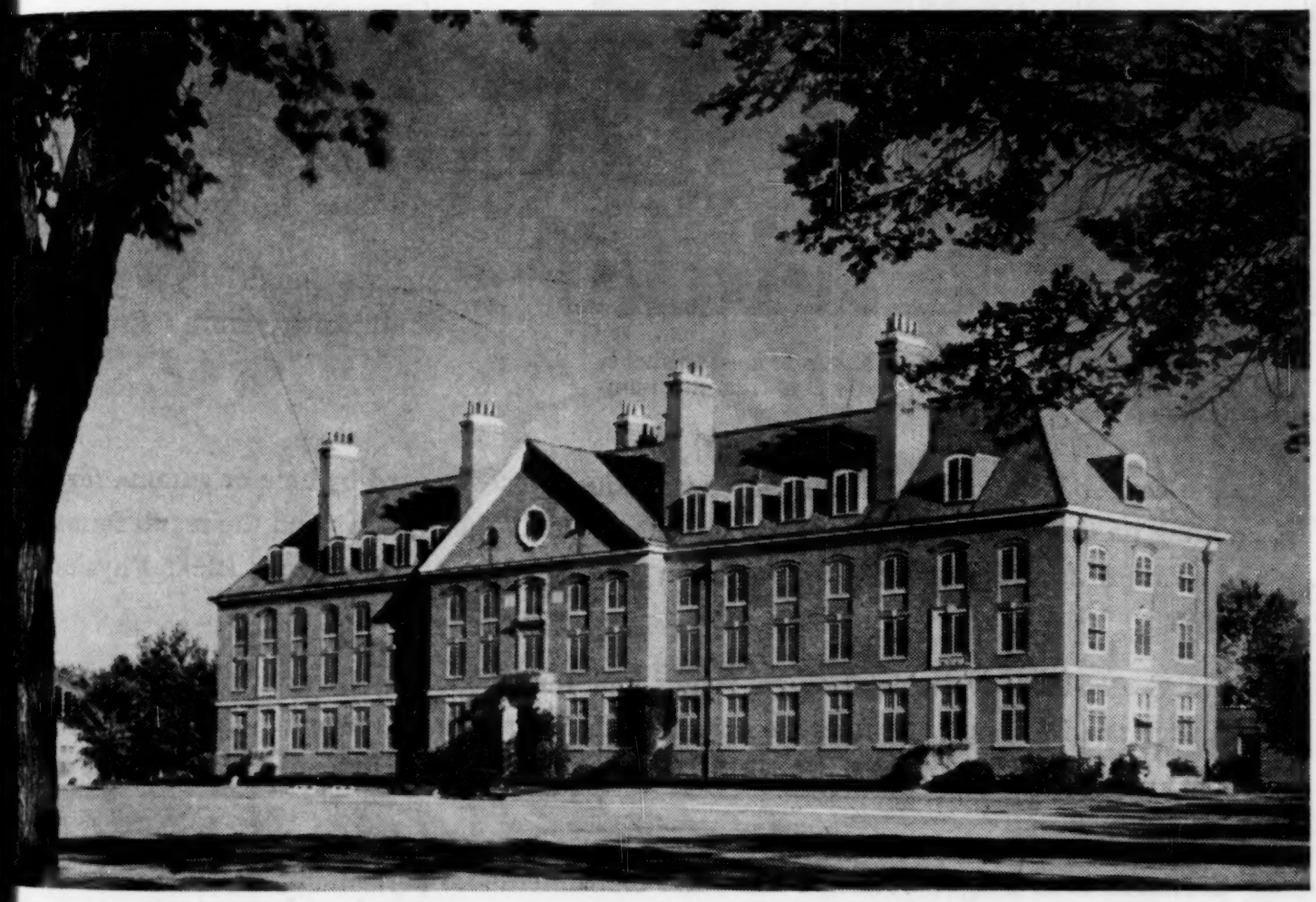
Vol. 105
No. 2736

Pages 587-606

June 6, 1947

Science

THE SCIENTISTS NEWSWEEKLY



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Natural Selection and Mental Capacities of Mankind

Th. Dobzhansky and M. F. Ashley Montagu

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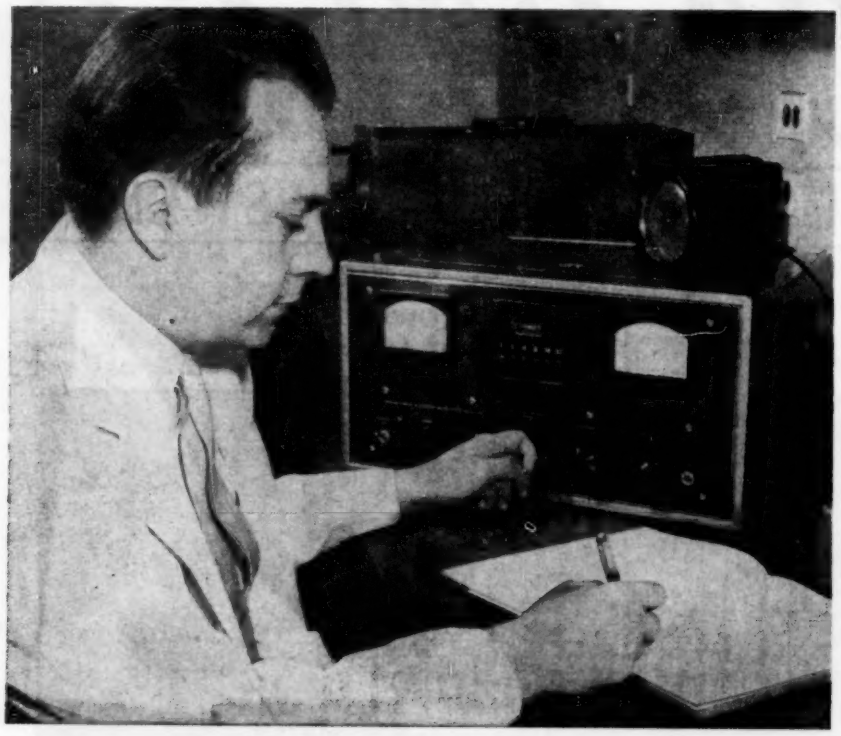

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Science

Vol. 105 No. 2736 Friday, June 6, 1947

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Science a weekly journal, is published each Friday by the American Association for the Advancement of Science at Mt. Royal & Guilford Avenues, Baltimore 2, Maryland. Founded in 1880, it has been since 1900 the official publication of the AAAS. Editorial, Advertising, and Circulation Offices, 1515 Massachusetts Avenue, N.W., Washington 5, D. C. Telephone, EXecutive 6060 or 6061. Cable address SCIMAG, Washington, D. C.

Articles offered for publication should be sent to the Editor, 1515 Massachusetts Avenue, N.W., Washington 5, D. C.

Membership correspondence for the AAAS should be sent to the Administrative Secretary, 1515 Massachusetts Avenue, N.W., Washington 5, D. C.

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Entered as second-class matter January 17, 1947, at the postoffice at Baltimore, Maryland, under the act of March 3, 1879.

Natural Selection and the Mental Capacities of Mankind

Th. Dobzhansky and M. F. Ashley Montagu

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THE FUNDAMENTAL MECHANISMS OF the transmission of heredity from parents to offspring are surprisingly uniform in most diverse organisms. Their uniformity is perhaps the most remarkable fact disclosed by genetics. The laws discovered by Mendel apply to human genes just as much as to those of the maize plant, and the processes of cellular division and germ cell maturation in man are not very different from those in a grasshopper. The similarity of the mechanisms of heredity on the individual level is reflected on the population level in a similarity of the basic causative factors of organic evolution throughout the living world. Mutation, selection, and genetic drift are important in the evolution of man as well as in amoebae and in bacteria. Wherever sexuality and cross-fertilization are established as exclusive or predominant methods of reproduction, the field of hereditary variability increases enormously as compared with asexual or self-fertilizing organisms. Isolating mechanisms which prevent interbreeding and fusion of species of mammals are operative also among insects.

Nevertheless, the universality of basic genetic mechanisms and of evolutionary agents permits a variety of evolutionary patterns to exist not only in different lines of descent but even at different times in the same line of descent. It is evident that the evolutionary pattern in the dog species under domestication is not the same as in the wild ancestors of the domestic dogs or in the now living wild relatives. Widespread occurrence of reduplication of chromosome complements (polyploidy) in the evolution of plants introduces complexities which are not found in the animal kingdom, where polyploidy is infrequent. Evolutionary situations among parasites and among cave inhabitants are clearly different from those in free-living forms. Detection and analysis of differences in the evolutionary patterns in different organisms is one of the important tasks of modern evolutionists.

It can scarcely be doubted that man's biological heredity is transmitted by mechanisms similar to those encountered in other animals and in plants. Likewise, there is no reason to believe that the evolutionary development of man has involved causative factors other than those operative in the evolution of other organisms. The evolutionary changes that occurred before the prehuman could become human, as well as those which supervened since the attainment of the human estate, can be described causally only in terms of mutation, selection, genetic drift, and hybridization—familiar processes throughout the living world. This reasoning, indisputable in the purely biological context, becomes a fallacy, however, when used, as it often has been, to justify narrow biologism in dealing with human material.

The specific human features of the evolutionary pattern of man cannot be ignored. Man is a unique product of evolution in that he, far more than any other creature, has escaped from the bondage of the physical and the biological into the multiform social environment. This remarkable development introduces a third dimension in addition to those of the external and internal environments—a dimension which many biologists, in considering the evolution of man, tend to neglect. The most important setting of human evolution is the human social environment. As stated above, this can influence evolutionary changes only through the media of mutation, selection, genetic drift, and hybridization. Nevertheless, there can be no genuine clarity in our understanding of man's biological nature until the role of the social factor in the development of the human species is understood. A biologist approaching the problems of human evolution must never lose sight of the truth stated more than 2,000 years ago by Aristotle: "Man is by nature a political animal."

In the words of Fisher, "For rational systems of evolution, that is, for theories which make at least the most familiar facts intelligible to the reason, we must turn to those that make progressive adaptation the driving force of the process." It is evident that man by means of his reasoning abilities, by becoming a "political animal," has achieved a mastery of the world's varying environments quite unprecedented in the history of organic evolution. The system of genes which has permitted the development of the specifically human mental capacities has thus become the foundation and the paramount influence in all subsequent evolution of the human stock. An animal becomes adapted to its environment by evolving certain genetically determined physical and behavioral traits; the adaptation of man consists chiefly in developing his inventiveness, a quality to which his physical heredity predisposes him and which his social heredity provides him with the means of realizing. To the degree to which this is so, man is unique. As far as his physical responses to the world are concerned, he is almost wholly emancipated from dependence upon inherited biological dispositions, uniquely improving upon the latter by the process of learning that which his social heredity (culture) makes available to him. Man possesses

much more efficient means of achieving immediate or long-term adaptation than any other biological species: namely, through learned responses or novel inventions and improvisations.

In general, two types of biological adaptation in evolution can be distinguished. One is genetic specialization and genetically controlled fixity of traits. The second consists in the ability to respond to a given range of environmental situations by evolving traits favorable in these particular situations; this presupposes genetically controlled plasticity of traits. It is known, for example, that the composition of the blood which is most favorable for life at high altitudes is somewhat different from that which suffices at sea level. A species which ranges from sea level to high altitudes on a mountain range may become differentiated into several altitudinal races, each having a fixed blood composition favored by natural selection at the particular altitude at which it lives; or a genotype may be selected which permits an individual to respond to changes in the atmospheric pressure by definite alterations in the composition of the blood. It is well known that heredity determines in its possessor not the presence or absence of certain traits but, rather, the responses of the organisms to its environments. The responses may be more or less rigidly fixed, so that approximately the same traits develop in all environments in which life is possible. On the other hand, the responses may differ in different environments. Fixity or plasticity of a trait is, therefore, genetically controlled.

Whether the evolutionary adaptation in a given phyletic line will occur chiefly by way of genetic fixity or by way of genetically controlled plasticity of traits will depend on circumstances. In the first place, evolutionary changes are compounded of mutational steps, and consequently the kind of change that takes place is always determined by the composition of the store of mutational variability which happens to be available in the species populations. Secondly, fixity or plasticity of traits is controlled by natural selection. Having a trait fixed by heredity and hence appearing in the development of an individual regardless of environmental variations is, in general, of benefit to organisms whose milieu remains uniform and static except for rare and freakish deviations. Conversely, organisms which inhabit changeable environments are benefited by having their traits plastic and modified by each recurrent configuration of environmental agents in a way most favorable for the survival of the carrier of the trait in question.

Comparative anatomy and embryology show that a fairly general trend in organic evolution seems to be from environmental dependence toward fixation of the basic features of the bodily structure and function. The appearance of these structural features in the embryonic development of higher organisms is, in general, more nearly autonomous and independent of the environment than in lower forms. The development becomes "buffered" against environmental and genetic shocks. If, however, the mode of life of a species happens to be such that it is, of necessity, exposed to a wide range of environments, it becomes desirable to vary some structures and functions in accordance with the circumstances that confront an individual or a strain at a given time and place. Genetic structures which permit adaptive plasticity of traits become, then, obviously advantageous for survival and so are fostered by natural selection.

The social environments that human beings have created everywhere are notable not only for their extreme complexity but also for the rapid changes to which immediate adjustment is demanded. Adjustment occurs chiefly in the psychical realm and has little or nothing to do with physical traits. In view of the fact that from the very beginning of human evolution the changes in the human environment have been not only rapid but diverse and manifold, genetic fixation of behavioral traits in man would have been decidedly unfavorable for survival of individuals as well as of the species as a whole. Success of the individual in most human societies has depended and continues to depend upon his ability rapidly to evolve behavior patterns which fit him to the kaleidoscope of the conditions he encounters. He is best off if he submits to some, compromises with some, rebels against others, and escapes from still other situations. Individuals who display a relatively greater fixity of response than their fellows suffer under most forms of human society and tend to fall by the way. Suppleness, plasticity, and, most important of all, ability to profit by experience and education are required. No other species is comparable to man in its capacity to acquire new behavior patterns and discard old ones in consequence of training. Considered socially as well as biologically, man's outstanding capacity is his educability. The survival value of this capacity is manifest, and therefore the possibility of its development through natural selection is evident.

It should be made clear at this point that the replacement of fixity of behavior by genetically controlled plasticity is not a necessary consequence of all forms of social organization. The quaint attempts to glorify insect societies as examples deserving emulation on the part of man ignore the fact that the behavior of an individual among social insects is remarkable precisely because of the rigidity of its genetic fixation. The perfection of the organized societies of ants, termites, bees, and other insects is indeed wonderful, and the activities of their members may strike an observer very forcibly by their objective purposefulness. This purposefulness is retained, however, only in environments in which the species normally lives. The ability of an ant to adjust its activities to situations not encountered in the normal habitats of its species is very limited. On the other hand, social organizations on the human level are built on the principle that an individual is able to alter his behavior to fit any situation, whether previously experienced or new.

This difference between human and insect societies is, course, not surprising. Adaptive plasticity of behavior n develop only on the basis of a vastly more complex rvous system than is sufficient for adaptive fixity. e genetic differences between human and insect socie- s furnish a striking illustration of the two types of olutionary adaptations—those achieved through ge- tically controlled plasticity of behavioral traits and ose attained through genetic specialization and fixation behavior.

The genetically controlled plasticity of mental traits is, logically speaking, the most typical and uniquely man characteristic. It is very probable that the sur- val value of this characteristic in human evolution has en considerable for a long time, as measured in terms of man historical scales. Just when this characteristic st appeared is, of course, conjectural. Here it is of in- rest to note that the most marked phylogenetic trend the evolution of man has been the special development the brain, and that the characteristic human plasticity mental traits seems to be associated with the excep- onally large brain size. The brain of, for example, the ower or Middle Pleistocene fossil forms of man was, rossly at least, scarcely distinguishable from that of odern man. The average Neanderthaloid brain was mewhat larger than that of modern man, though slightly fferent in shape. More important than the evidence erived from brain size is the testimony of cultural velopment. The Middle Acheulean handiwork of Swans- mbe man of several hundred thousand years ago and e beautiful Mousterian cultural artifacts associated th Neanderthal man indicate the existence of minds a high order of development.

The cultural evidence thus suggests that the essentially man organization of the mental capacities emerged ite early in the evolution of man. However that may be, e possession of the gene system, which conditions edu- bility rather than behavioral fixity, is a common prop- ty of all living mankind. In other words, educability is uly a species character of man, *Homo sapiens*. This does t mean, of course, that the evolutionary process has n its course and that natural selection has introduced changes in the genetic structure of the human species nce the attainment of the human status. Nor do we sh to imply that no genetic variations in mental equip- ent exist at our time level. On the contrary, it seems kely that with the attainment of human status that rt of man's genetic system which is related to mental tentialities did not cease to be labile and subject to ange.

This brings us face to face with the old problem of the kelihood that significant genetic differences in the men- l capacities of the various ethnic groups of mankind ist. The physical and, even more, the social environ- ents of men who live in different countries are quite versified. Therefore, it has often been argued, natural selection would be expected to differentiate the human species into local races differing in psychic traits. Populations of different countries may differ in skin color, head shape, and other somatic characters. Why, then, should they be alike in mental traits?

It will be through investigation rather than speculation that the problem of the possible existence of average differences in the mental make-up of human populations of different geographical origins will eventually be settled. Arguments based on analogies are precarious, especially where evolutionary patterns are concerned. If human races differ in structural traits, it does not necessarily follow that they must also differ in mental ones. Race differences arise chiefly because of the differential action of natural selection on geographically separated populations. In the case of man, however, the structural and mental traits are quite likely to be influenced by selection in different ways.

The very complex problem of the origin of racial differentiations in structural traits does not directly concern us here. Suffice it to say that racial differences in traits such as the blood groups may conceivably have been brought about by genetic drift in populations of limited effective size. Other racial traits are genetically too complex and too consistently present in populations of some large territories and absent in other territories to be accounted for by genetic drift alone. Differences in skin color, hair form, nose shape, etc. are almost certainly products of natural selection. The lack of reliable knowledge of the adaptive significance of these traits is perhaps the greatest gap in our understanding of the evolutionary biology of man. Nevertheless, it is at least a plausible working hypothesis that these and similar traits have, or at any rate had in the past, differential survival values in the environments of different parts of the world.

By contrast, the survival value of a higher development of mental capacities in man is obvious. Furthermore, natural selection seemingly favors such a development everywhere. In the ordinary course of events in almost all societies those persons are likely to be favored who show wisdom, maturity of judgment, and ability to get along with people—qualities which may assume different forms in different cultures. Those are the qualities of the plastic personality, not a single trait but a general condition, and this is the condition which appears to have been at a premium in practically all human societies.

In human societies conditions have been neither rigid nor stable enough to permit the selective breeding of genetic types adapted to different statuses or forms of social organization. Such rigidity and stability do not obtain in any society. On the other hand, the outstanding fact about human societies is that they do change and do so more or less rapidly. The rate of change was possibly comparatively slow in earlier societies, as the rate of change in present-day nonliterate societies may be, when compared to the rate characterizing occidental so-

cieties. In any event, rapid changes in behavior are demanded of the person at all levels of social organization even when the society is at its most stable. Life at any level of social development in human societies is a pretty complex business, and it is met and handled most efficiently by those who exhibit the greatest capacity for adaptability, plasticity.

It is this very plasticity of his mental traits which confers upon man the unique position which he occupies in the animal kingdom. Its acquisition freed him from the constraint of a limited range of biologically predetermined responses. He became capable of acting in a more or less regulative manner upon his physical environment instead of being largely regulated by it. The process of natural selection in all climes and at all times have favored gen types which permit greater and greater educability a plasticity of mental traits under the influence of t uniquely social environments to which man has be continuously exposed.

The effect of natural selection in man has probabl been to render genotypic differences in personality trai as between individuals and particularly as between race relatively unimportant compared to their phenotyp plasticity. Instead of having his responses genetical fixed as in other animal species, man is a species th invents its own responses, and it is out of this uniqu ability to invent, to improvise, his responses that his cu tures are born.

The Problems of Gerontology

Roy G. Hoskins, *Director of Researc*
Memorial Foundation for Neuro-Endocrine Researc
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WITHIN RECENT DECADES THE specialty of pediatrics has developed out of the general field of medicine, and with this specialization progress in promotion of the welfare of children has been largely accelerated. It is rather remarkable that until lately the opposite stretch of the life span has remained a largely neglected field of interest. There is abundant reason to believe that comparably focalized interest in the problems of aging will yield much of profit not only to the elderly themselves but also to society at large. All the various approaches to this problem are incorporated in the science of gerontology.

Generally speaking, the methodology of gerontological research amounts simply to contrasting the youthful and the aging organisms with respect to their various biological characteristics. By the introduction of this comparative feature, almost any research in any field of biology, from that of biochemistry to that of sociology, can be made, in effect, a research in gerontology. This is equally true whether the given research is addressed to description or to experimentation. An important aspect of investigative gerontology is therapeutic research. Thanks to the fact that large aggregations of elderly persons are available in different sorts of eleemosynary institutions, it is possible to set up this type of study with more adequate controls than are possible in many other sorts of therapeutic research.

At the *molecular level* of integration[1] many studies are needed. A few sorts of these may be particularize One functionally important class of molecules is th amino acids. In view of the special influences of vario of these on the processes of cell differentiation and ma uration, significant correlations might be found betwe amino-acid metabolism and acceleration or retardati of the aging processes as well as the biological efficien of the organism at any given age. Various other me abolically important molecules, such as cholester and folic acid, also demand consideration.

Much remains to be elucidated about the differe internal secretions. The two major problems in th part of the field involve determination, at various ag of the levels of production of the several hormon and the reactivity of the body to each. What is part known regarding the influences of the gonadal, the th roid, the adrenal, and the anterior pituitary hormon on maturation processes renders further studies alon this line imperative. A chief methodological need is t bring to bear the latest advances in the field of physic chemistry in the hope of deriving technics for the quant tative appraisal of the titers of each of the hormon in the circulating blood. Until this is accomplishe we shall have to continue to limp along, deriving suc information as is possible from studies of urinary e cretion of the hormones or their end metabolites. Ge erally speaking, the entire endocrinology of the senescen and senile periods is in need of further study.

An equally persuasive case can be made for a stud of the different vitamins in relation to the aging pro esses and to the various organic functions in pos mature individuals. A modicum of information

[1] For a recent discussion of the concepts of integrative evolution, see Novikoff (*3*). A discussion of the applicability of the concepts to a larger biological problem has been offered by the writer (*2*).

vailable indicating that anomalies of vitamin assimilation and metabolism are characteristic of the aged, but uch more particularized knowledge of each of these ontrolling agents is needed in relation to both health nd disease. The functional interrelations of the vitamins ith each other and with the hormones demand further tudy.

Perhaps more important than any of these other pecialized molecules are the enzymes by which cellular hemistry is so largely regulated. Both the formation f, and reactions to, the hormones are seemingly matters rgely of special enzyme metabolism. Presumably, he enzymes play an equally important role in vitamin etabolism. Underlying many of the pathological proc-sses as they become visibly manifested in cells and rgans are, no doubt, perturbations of enzyme factors n metabolism. Many years of searching investigation f the enzyme physiology and pathology of senescence re obviously needed.

A major aspect of all the above-mentioned problems s a determination of the extent to which the various nomalies and their consequences in form and function re reversible at the various age periods. A special facet f this problem is the therapeutic possibilities of these arious agents for retardation or amelioration of senes-ence.

Turning to manifestations at the *cellular level*, we nd that these are to a considerable extent obvious onsequences of phenomenology at the molecular level. here are, however, important aspects of cell biology hat cannot be studied in terms of immediate chemistry. n general, these include the form, size, structure, dif-erentiation, and integrity of cells. It is at this level hat much of the phenomenology of pathology as now isualized appears. The aspects of cellular pathology hat are most obviously important to gerontology are eoplastic growths and degenerative changes in the arious tissues. The need for the development of a more dequate functional cytology is evident. In various ays the microchemistry of the cells already lends itself o study, and other methods no doubt will appear as the esources of the newer physical chemistry are brought o bear. The recent work of Dempsey and his colleagues eems especially promising to this end. These latter pproaches seem, on the whole, more promising for the lucidation of cellular physiology and pathology than oes electron microscopy. The influences of imposed ariations in hormone, vitamin, and enzyme factors on ytology—and especially functional cytology—offer cope for many investigations in this field.

At the *organ-function* level of emergence appear the rchitecture and the activities of the organs and organ ystems, *as such*. Generally speaking, productive studies t this level require different concepts and technics han at the metabolic or cellular level. Most of the o-called "vital-function" tests pertain to this level, e.g. "gastric-acidity," "renal-function," or "liver-function" tests; and it is also at this level that the principles of homeostasis as elucidated by Cannon largely operate. Phenomena at this level make up a large part of the subject matter of geriatrics as now visualized. Numerous of the most obvious problems of gerontology consist of comparisons of elderly and younger individuals with respect to organ efficiency and of therapeutic measures to improve such efficiency. The problem of promoting longevity is customarily studied chiefly at this level, although studies at the molecular level might actually be more productive.

At the *simple behavioral level* we first have to deal with the "organism as a whole." At this level such manifestations as maze learning, breeding patterns, nest building, and various sorts of still more primitive behavior come to attention. This category of activities is a matter of much interest in comparative biology, but in the case of human beings the phenomenology can profitably be studied for the most part in connection with those of the next higher level, the psychological or ego-oriented.

At the *psychological level* appear those many biological manifestations in which the neopallium plays an important or dominant role and in which "reactions in consciousness" are the matters of central interest. Much of the existing knowledge of activities at this level is conceptualized in terms of ego function. Here we deal with that vast array of items that make up the subject matter of psychology and psychiatry as organized disciplines, and here many of the most important problems of gerontology arise. It is the operation of factors at this level that largely determines whether longevity promoted at lower levels is actually worth the while of the individual himself.

In this necessarily brief discussion adequate presentation of the psychology of senescence is impossible. The place of psychology in the total over-all problems of gerontology can, however, be indicated. Many of the older technics can still be utilized and, as newer technics appear, these too can be applied to the elucidation of the differential characteristics of the aging.

Obviously, the chief desiderata in the later years are a sense of physical well-being and feelings of interest and contentment. The possibilities of psychotherapy for the aging center largely in the last-mentioned item. Individual therapeutic efforts and organized projects addressed to individual psychological welfare are most productively based on a consideration of the fundamental human drives as these have been derived through the long course of evolution. The relative potencies of the drives can be appraised in accordance with their operational significance in promoting individual or group survival.

Throughout the evolutionary period superiority has been a necessity for survival. This necessity is rep-

resented subjectively by the sense of self-esteem. A primary requisite to individual contentment, then, is the preservation of a tolerable degree of self-esteem.

The need for a sense of security is likewise of obvious importance and can be dealt with to some degree at the psychological level—but the problems are rather more social and economic. A sense of insecurity is a chief cause of anxiety, which not only deprives the individual of contentment but likewise leads to numerous perturbations at the physiological level. Since these latter are often life shortening, a part of the actual problem of longevity lies at the psychological level. Anxiety, as such, can be controlled in a measure by psychotherapy. Some of the simpler means to this end have been discussed elsewhere (*1*).

As to other possibilities for research at this level, only one further hint will be offered. Most of the drives that have to be considered are those addressed to individual survival. The gregarious pattern of living which our ancestors evolved is implemented to a considerable extent by another set of drives—those addressed to group survival. A major factor here is the sense of group solidarity; at the individual conscious-emotional level, this "sense" may be designated as "empathy" (*2*). A lively degree of empathy is a requisite to inner health and hence to contentment.

The upper limit to which the processes of integrative evolution have carried our species is the *social level*, and it is at this level that some of the most important problems of gerontology are presented. Issues of large moment hang on the fact that the modal citizen is constantly becoming an older person. Many social and especially economic adjustments to that fact are increasingly demanding attention. Not only, of course, is the welfare of the aged involved but that of the younger groups as well. The need for the development of more adequate technics for research at the social level is obvious—indeed, our survival as a species is involved.

The central problems of gerontology at this level are those of adapting the aging individual to the changing society and of evolving social patterns in which the values of the older individuals can most adequately be utilized. The impressive work of Lawton in New York is showing with increasing clarity how studies at this level can yield much in the way of enhancing the contentment of the elderly. Perhaps equally important to this end are the studies of Ford and others on the possibilities of utilizing the older workmen in industry.

Belatedly, several specialized agencies are now in process of development for the promotion of gerontolog Geriatrics, having to do with diseases of the elderly, h its recently organized society and its journal, *Geriatri* Less than a year ago a broader approach was visualiz in the organization of the Gerontological Society, Inc and the founding of the *Journal of Gerontology*. Th Society and its journal propose to deal with the problem of aging from all the relevant and significant points view. It is expected to enlist the cooperation and suppor not only of physicians but of other serious students, suc as biologists, physiologists, pathologists, psychologist sociologists, economists, and administrators—in short, all who are contributing actively to the solution of th problems of aging. During the first year of its existen the Gerontological Society has been engaged primarily i the building up of a strong and representative body charter members. Information regarding this organizatio can be obtained from the secretary, Dr. Henry S. Simm 630 West 168th Street, New York 32, New York. Ap plications for membership are welcome.

A still more recent development is the setting up of Gerontology Study Section in the Research Grant Division of the National Institute of Health (*4*). Unde the chairmanship of Dr. Henry S. Simms, Columbi University Medical Center, and the secretaryship Dr. Nathan W. Shock, National Institute of Healt Bethesda, Maryland, this Section proposes to take a aggressive and constructive part in promoting progre in its field. The Federal law under which the Researc Grants Division operates permits much freedom action both to the Section and to cooperating invest gators. Especially noteworthy are the thoughtful pr visions that have been set up to insure freedom of acti and responsibility of the immediate proponents. It presumed that adequate funds will be available for th support of any sound projects that may be offered devised by the Section itself. Another provision of maj promise for advancement over the longer period is f generously-funded training fellowships. In short, at lo last, the way is broadly opened for the support and en couragement of researches of any and all sorts for th welfare and social utilization of the aging members society.

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A Tax Credit Plan for Re-establishing Private Support of Pure Science

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THE HEAVY TAXES NOW LEVIED against incomes have virtually dried up private support for American science. Its revival need not, however, be contingent upon the return of that visionary day when the Federal budget will again approach its predepression size. Another and very simple means is at hand. Being flexible to a high degree, this means can be made sufficiently productive to carry the full load of pure science, or it can be operated in parallel with the appropriation of funds from the Federal Treasury.

By way of explanation of the plan, let us first note the inequalities of reckoning which the income tax law now accords to different income classes. Assuming that our goal is to complete a certain budgetary quota for pure science, each dollar entering the quota should be counted as of equal value, irrespective of its source. In other words, the dollar contributed voluntarily to science should count equally with the dollar processed by the tax collector. Under the present tax formulas, however, this is not the case. The person who voluntarily donates a $1.00 finds his tax reduced not by $1.00 but by an amount lying between the approximate limits of $.19 and $.85, depending upon whether he stands at the low or the high end of the income scale. As for a contributing corporation, its dollar counts for a maximum of $.38. If science is hereafter to receive support partly from private donations and partly from the Federal Treasury (an arrangement that many advocates of Federal aid hope for), it seems definitely illogical that the only dollars to count at full value should be those taken, and later contributed, by the tax collector.

While recognizing that inconsistencies in the tax schedules are nothing new and are perhaps not overly embarrassing to tax authorities, I wish to emphasize, nonetheless, that the removal of these disparities might readily suffice to produce even greater support for science than any one dreams of asking from the Government. In short, the rectification which becomes logical, were Treasury funds to be drawn upon to participate jointly with private aid, might well result in making the Treasury funds unnecessary.

Let us now see how the plan might operate in the current year. The total income tax payments from individuals on incomes earned in 1946 is (in round figures) $18,000,000,000. In the tax discussions now taking place in Congress, reductions in individual taxes ranging from 10 to 30 per cent are mentioned. If it is supposed that the amounts finally agreed upon average 15 per cent, then, using for 1947 the 1946 base of $18,000,000,000, this would represent a reduction of $2,700,000,000. This reduction is so large that a few per cent of it would equal any sum that has been mentioned as appropriate for additional aid to science, and when the contributions that may be expected from corporations are taken into account, the sum that would be needed from private donors becomes even a smaller quantity in comparison with the presumptive tax reduction.

The specific proposal, then, is that, from the shortly-to-be-established tax reduction, Congress channel approximately 2–3 per cent to science by the expedient of informing the taxpayer that he will get full tax credit for any contribution (up to, say, 5 per cent of his income) which he makes to approved scientific agencies. Many of these contributions, and especially those from corporations, would be made to the National Science Foundation if, as may reasonably be assumed, such a body is created. If any taxpayer does not elect to make such a contribution, he may expect the tax collector to demand an equal sum. As a matter of fact, adequate support may reasonably be expected to flow from the recipients of large incomes alone (*i.e.* from the group who are already accustomed to making systematic contributions) without drawing from the small-income groups, the mobilization of which might well require considerable time and effort.

Although here expressed in terms of a percentage of the pending tax reduction, the credit system is, of course, envisaged as applying year after year, the mechanism being the same whether or not a tax reduction for any year is in prospect. The allowable credit would be stated as a fraction of the taxpayer's net income (5 per cent, for example), and, while this fraction might be subject to modification from time to time, any change would be incidental to the operation of the plan. There might, however, be some advantage from the taxpayer's standpoint in launching the plan in a year when a tax reduction is in prospect. It might be mentioned that the plan has been discussed with tax experts and is believed to involve no hidden difficulties of administration.

But, it will be objected, the plan grants to pure science

This plan has been placed before Congress, but its details and the reasons for its proposal are not generally understood among scientists. The plan was referred to by F. B. Jewett in his recent statement before the House Committee on Foreign and Domestic Commerce.

the privilege of a special tax treatment which would not be accorded the many other forms of philanthropy. This is true; yet such a charge is even more to be leveled against the proposal to support science out of Federal funds. This represents the very pinnacle of partiality. No possible course of action could give science a more favored position, and if any charge of favoritism is to be brought, the plan of Treasury aid is clearly more liable than the plan for modifying the income tax formulas.

Moreover, the charge of partiality against the plan becomes even weaker if the tax credit is allowed to apply to donations to educational purposes generally. Expressing the basic doctrine that universal education is essential to our democratic way of life, governments, both state and federal, have traditionally encouraged and supported virtually all forms of education. In fact, any proposal to put greater stress upon higher education and research—the current appeal for a National Science Foundation being a case in point—can succeed only as it is supported upon a broad and effective base. At this very time, many of our leading universities are more in need of funds to defray current expenses than for more scholarships, fellowships, and research. It is therefore pertinent to point out that the tax credit plan here proposed is so flexible that it could be used, were Congress so minded, to create a broad-gauge and long-range program in aid of American scholarship in all its branches.

Everyone recognizes that many of the serious postwar problems looming up are not in the domain of the exact sciences at all, although many of them have had their birth in the social and political consequences of technology. As a nation, our success in the future depends increasingly upon broadening our understanding of such areas of learning as sociology, political science, economics, and psychology—call them sciences or not, as we choose. Congress can, if it will, shore up the entire foundations of American learning and scholarship and do so in a manner that will need little, if any, surveillance for a long time to come. Moreover, this can be done without enacting any novel legislation. It may be expected to occur spontaneously, once there is inaugurated the income tax credit that is deductible from the tax that is otherwise payable.

NEWS *and Notes*

The British Association for the Advancement of Science has invited Kirtley F. Mather, Harvard University, to deliver a lecture at its Dundee meeting (*Science*, May 16) under the exchange lectureship arrangement entered into by the AAAS and the BAAS in 1938. The Council of the BAAS has extended an invitation to Andrew C. Ivy, University of Illinois Medical School, Chicago, to be the guest of the Association at this meeting.

About People

H. A. Wilhelm, Department of Chemistry, Iowa State College, has been appointed assistant director of the Iowa State College Institute for Atomic Research. Ellis I. Fulmer, professor of chemistry at Iowa State, will join the staff of the Institute as research professor and assistant to the director.

C. C. Wylie, professor of astronomy, State University of Iowa, and secretary of Section D, AAAS, has been appointed director of the recently created Meteor Section of the Meteoritical Society.

Neal A. Weber, formerly associate professor of anatomy, University of North Dakota Medical School, has been appointed associate professor of zoology at Swarthmore College.

Henry S. Johnson, dean, College of Pharmacy, University of Connecticut, retires this month from his administrative duties but will continue on the staff as professor of chemistry. Dr. Johnson, who has been associated with the College since it was opened in 1925, is succeeded as dean by H. G. Hewitt, Department of Chemistry, University of Buffalo.

A. H. Compton, chancellor of Washington University, St. Louis, delivered the principal address at the dedication of the Iowa State College Institute for Atomic Research May 17.

Willard A. Kerr, assistant professor of industrial and social psychology, Tulane University, has been appointed associate professor of psychology and education, Illinois Institute of Technology, effective September 1.

Alfred L. Kroeber, formerly professor of anthropology, and director, Museum of Anthropology, University of California, Berkeley, has been appointed visiting lecturer on anthropology in the Department of Social Relations, Harvard University, for the academic year 1947–48.

Frank T. Gucker, Jr., professor of chemistry, Northwestern University, has been appointed professor of chemistry and chairman, Department of Chemistry, Indiana University, and will assume his duties there in September.

George Bachmann, professor emeritus of physiology, and chairman, Department of Physiology, School of Medicine, Emory University, for the past 37 years, will retire at the end of the present academic year.

H. P. Robertson, a member of the faculty of Princeton University since 1928, has been appointed professor of mathematical physics, California Institute of Technology, effective July 1.

J. Gordon Carlson, senior biologist at the National Institute of Health, Bethesda, Maryland, has been appointed professor and head of the Department of Zoology, University of Tennessee, Knoxville. He will assume his duties there on June 15.

Donald Sheehan, professor of anatomy and lately acting dean of the New York University College of Medicine, has

been appointed general director of the Commonwealth Fund, succeeding Barry C. Smith, who will retire September 1.

Carl W. Blegen, professor of classical archaeology and fellow of the Graduate School of Arts and Sciences, University of Cincinnati, is en route to Greece to complete arrangements for the University's next excavation project at the site of the Palace of King Nestor at Pylos. Dr. Blegen, who directed the University's seven annual archaeological expeditions to the site of ancient Troy in the 1930's, also plans to go to Turkey to check the details for a final report of the Trojan excavations, now being prepared in book form under his direction.

E. C. Watson, professor of physics at California Institute of Technology, has been appointed chairman of the Division of Physics, Mathematics, and Electrical Engineering, a position formerly held by William V. Houston, now president of Rice Institute.

Byron B. Clark, associate professor of physiology and pharmacology at Albany Medical College, has been appointed professor of pharmacology at Tufts College Medical School and will assume his duties there on July 1.

Martin Kilpatrick, professor of chemistry at the University of Pennsylvania, has been appointed chairman of the Department of Chemistry at Illinois Institute of Technology, effective September 1. During the war, Dr. Kilpatrick served as assistant to the director of research on the atom bomb project at Columbia University and also as consultant and coordinator for the U. S. Navy Bureau of Ordnance.

Leon M. Pultz, professor of botany, and head, Department of Botany and Range Ecology, University of Arizona, has been appointed professor of horticulture and head, Department of Horticulture, effective July 1. His present position will be filled by Walter S. Phillips, associate professor of botany at the University.

W. Henry Hollinshead, professor of anatomy and one of the original members of the staff of the Duke University School of Medicine, has been appointed professor of anatomy at the Mayo Foundation and Graduate School of Medicine, University of Minnesota. As of July 1 he will organize and head a Department of Anatomy being established by the Mayo Clinic.

Edward K. Bender, recently assistant county agent in Montgomery County, Maryland, has been appointed to the Extension Staff of the University of Maryland as vegetable crop specialist in the Department of Horticulture. He previously taught agricultural courses for the U. S. Navy.

Andrew A. Marchetti, associate professor of obstetrics and gynecology, Cornell University Medical College, and attending obstetrician and gynecologist at the New York Hospital, has been appointed professor and head of the Department of Obstetrics and Gynecology, Georgetown University School of Medicine and Georgetown University Hospital.

Howard D. Lightbody, formerly chief of the Biochemical Division, Western Regional Laboratory, Albany, California, has been appointed chief of the Food Research and Development Division, Quartermaster Food and Container Institute, Chicago.

Visitors to U. S.

James A. D. Nash, of the Department of Scientific and Industrial Research, Wellington, New Zealand, has recently arrived in Washington, D. C., to succeed G. Maskill Smith as head of the New Zealand Scientific Liaison Office.

W. H. George, head of the Department of Physics, Chelsea Polytechnic Institute, London, is in this country until September 3. On his visit, which is sponsored by the Ministry of Education, he will study science teaching and research in American colleges and universities, with special reference to physics. Dr. George is available for lectures on the scientific method and will be glad to know of any work on the teaching of this subject. He may be reached in care of The British Information Services, 30 Rockefeller Plaza, New York 20, New York.

José María Perelló, professor of pharmacognosy, University of Madrid, and head, Division of Physiology, Institute of Pharmacognosy, is visiting the University of California, Berkeley, to observe techniques in plant nutrition and physiology and review literature in his fields of interest. He will visit other American institutions and those in several Hispanic-American countries before returning to Spain. Also visiting the University of California from the same University and Institute is Luis Recalde, who is studying the problems of genetics as related to pharmacognosy.

C. J. Gorter, professor of physics and co-director, Physical Institute, University of Leiden, and formerly Zeeman professor of physics, University of Amsterdam, will be a visiting lecturer at Harvard University for the 1947 summer term. He will conduct one course in advanced dynamics and one in relaxation phenomena. The latter will treat magnetic and dielectric absorption and dispersion in alternating fields, a subject in which Prof. Gorter has made outstanding contributions.

Corneille Heymans, professor of pharmacology, University of Ghent, has been visiting the University of Minnesota to work with Ernst Gellhorn, professor of neurophysiology, on a program of experimentation concerning the central nervous system, circulation, and respiration. On May 13 Dr. Heymans gave a special address at a meeting of the Minnesota Pathological Society on "The Role of Presso- and Chemoceptors in the Regulation of Respiration."

Grants and Awards

The New York Academy of Sciences announces that three prizes, offered by A. Cressy Morrison and to be known as the A. Cressy Morrison Prizes I, II, and III, are to be awarded in December 1947. Prize I, of $500, which is open to anyone, is offered for the paper judged by the Council of the Academy to be the most meritorious contribution on the subject of the source of solar and stellar energy. Prizes II and III, of $200 each, which are open only to members of the Academy and its affiliated societies, will be awarded for the two most acceptable papers in any field of science covered by the Academy or an affiliated society. Further details may be obtained from the Executive Secretary, New York Academy of Sciences, Central Park West at 79th Street, New York City. The closing date is October 15, 1947.

McGill University, Montreal, Canada, will receive a grant-in-aid from the Bristol-Myers Company to enable it to establish a Research Institute of Biophysics within the Department of Medicine of the McGill University Medical School, and to establish fellowships for

study within the Research Institute. Work at the Institute, which is to be under the direction of Kenneth A. Evelyn, McGill University, will embrace laboratory and clinical investigations in the field of medical radioactivity and cardiovascular research.

Carl F. Cori, Washington University Medical School, St. Louis, is the recipient of the second intermediate Sugar Research Prize of $5,000, awarded annually by the National Science Fund of the National Academy of Sciences in recognition of the development of original knowledge about sugar. William C. Stadie, professor of research medicine, University of Pennsylvania, made the presentation in behalf of the National Science Fund. One of Dr. Cori's most significant contributions is the indication of the manner in which insulin influences the burning of sugar. Dr. Cori is also credited with notable discoveries about the metabolism of tumors, the disposition of sugar in the body, and the role of organophosphates and hormones on metabolism. His investigations also led to the discovery of the enzymes, phosphorylase and hexokinase. The award was presented at the annual dinner of the Foundation held at the Yale Club, New York, on April 28.

Matthew Luckiesh, director, Lighting Research Laboratory, General Electric Corporation, will be the recipient of the I.E.S. Gold Medal, to be presented at the Illuminating Engineering Society National Technical Conference on September 15–19 in New Orleans. The medal is given annually by the Illuminating Engineering Society "for meritorious achievement which has conspicuously furthered the profession, art, and knowledge of illuminating engineering."

Otto Stuhlman, Jr., professor of physics, University of North Carolina, received the Poteat Award at the 64th annual meeting of the North Carolina Academy of Science, held at Wake Forest College May 9–10, in recognition of his biophysical paper, "A Dynamical Analysis of the Movements of the Lobes of the Venus' Flytrap."

Presidential Medals for Merit have been presented to four prominent scientists for outstanding contributions to the Navy's war effort in the development and application of new techniques, weapons, and devices used in World War II. Those receiving the awards were: John Torrence Tate, chairman of research and professor of physics, University of Minnesota; Frederick Vinton Hunt, chairman of the Department of Engineering Sciences, Harvard University; Gaylord P. Harnwell, chairman of the Department of Physics and director of the Randal Morgan Laboratory of Physics, University of Pennsylvania; and William Vermillion Houston, president of Rice Institute. The medals were presented by Assistant Secretary of the Navy W. John Kenney on May 5.

Fellowships

The Johns Hopkins University has announced the establishment by the International Nickel Company of a graduate fellowship of $1,900 in the School of Engineering. This fellowship is open to graduate students in engineering and may be held for two consecutive years, during which the recipient must devote himself to study and research dealing with developments in the properties and applications of nickel, copper, platinum, or alloys containing any of these metals. It is anticipated that the fellowship will be most applicable to the work of students in the fields of mechanical, chemical, or electrical engineering. Applications should be sent to the Dean of Engineering, The Johns Hopkins University, Baltimore 18, Maryland, by July 1, 1947.

Summer Programs

The University of Michigan College of Engineering offers a Smyposium on Fluid Mechanics and several advanced courses in engineering during its summer session, June 23–August 16. The course, Engineering Mechanics 141, will be conducted largely by Hunter Rouse, director, Institute of Hydraulic Research, State University of Iowa, and Sydney Goldstein, University of Manchester, England. Others conducting lectures and seminars during the summer session will include: Boris A. Bakhmeteff, professor of civil engineering, Columbia University; Hugh L. Dryden, assistant director, National Bureau of Standards; J. E. Warnock or D. J. Hebert, Bureau of Reclamation; L. G. Straub, professor of civil engineering and director, St. Anthony Falls Laboratory, University of Minnesota; John Stack, chief, Compressibility Division, NACA Laboratory, Langley Field; V. L. Streeter, research professor in mechanics, Illinois Institute of Technology; M. J. Thompson, professor and chairman, Department of Aeronautical Engineering, University of Texas; Th. von Kármán, California Institute of Technology; and various members of the University faculty. For information concerning the courses or requirements for graduate credit, correspondence should be addressed to Prof. L. A. Hopkins, Director, Summer Session, University of Michigan, Ann Arbor, Michigan.

Meetings

A symposium on "Recent Biophysical Advances in Physiology" is to be held on June 11 under the auspices of the Medical Division, Army Chemical Center, Edgewood, Maryland. The morning session will include the following papers: "New Techniques for Micro Gas Analysis," Per F. Scholander, Swarthmore College; "Respiration in Diving Animals," Laurence Irving, Swarthmore College; "Biophysical Studies of Acceleration," E. J. Baldes, Mayo Clinic, Rochester, Minnesota; and "Instrumentation in Bioclimatological Research," Victor Guillemin, Aero Medical Laboratory, Wright Field, Dayton, Ohio. The following papers will be included in the afternoon session: "Kinetics of Reaction of Oxygen and Carbon Monoxide With Hemoglobin *in Vivo and in Vitro*," F. J. W. Roughton, Cambridge, England; "Measurement and Significance of Oxygen Consumption in the Nervous System," Detlev W. Bronk, Johnson Foundation, University of Pennsylvania; and "Applications of Electrical Excitation," H. A. Blair, University of Rochester.

Interested physiologists are welcome to attend. Inquiries regarding the symposium may be addressed to Col. John R. Wood, Chief, Medical Division, or to David B. Dill, Scientific Director.

The 10th National Organic Chemistry Symposium of the American Chemical Society will be held in Boston June 12–14 under the joint sponsorship of the Society's Division of Organic Chemistry and Northeastern Section.

The technical sessions, under the chairmanship of Arthur C. Cope, of Massachusetts Institute of Technology, will feature papers on: "Naphthoquinones," by Louis F. Fieser, Harvard University; "Influence of Substituents on Polarity in the Benzene Ring," Charles

C. Prince, University of Notre Dame; "The Behavior of Organic Compounds in Sulfuric Acid Solution," Melvin S. Newman, Ohio State University; "Recent Studies in Steric Effects," Paul D. Bartlett, Harvard University; "Alkylation by Amines and Amine Derivatives," H. R. Snyder, University of Illinois; "Chemistry of the Sphingolipids," Herbert E. Carter, University of Illinois; "Synthesis of Unsaturated and Bridged Eight-membered Ring Compounds," Dr. Cope; "Synthesis of Some Compounds Related to the Female Sex Hormones," A. L. Wilds, University of Wisconsin; "Some Sulfur-containing Amines," Chester M. Suter, Sterling-Winthrop Research Institute, Rensselaer, New York; "The Stobbe Condensation and the Synthesis of Fused Ring System," William S. Johnson, University of Wisconsin; "The Chemistry of Cyclopentadiene Polymers and Adducts," Herman A. Bruson, Resinous Products & Chemical Company, Philadelphia; and "The Stereochemistry of Five- and Six-membered Rings," Richard T. Arnold, University of Minnesota.

James B. Conant, honorary chairman of the symposium, will speak at the symposium dinner on June 13 at the Hotel Statler, headquarters for the meeting.

The University Conference on Corrosion and Metal Protection, to open at the Museum of Science and Industry, Chicago, on June 11 for a three-day session, will feature technical papers of a quantitative and research character which emphasize the science background of corrosion rather than the art of corrosion testing and practice. Henry T. Heald, president, Illinois Institute of Technology, will present the opening address, which will be followed by the presentation of papers. Those participating are: Mars G. Fontana, Ohio State University; Norman Hackerman, University of Texas; G. A. Marsh and R. D. Misch, Illinois Institute of Technology; R. L. Starkey, New Jersey Agricultural Experiment Station; C. V. King, New York University; Thomas C. Poulter, Armour Research Foundation; C. F. Prutton and David Turnbull, Case School of Applied Science and General Electric Company, respectively; H. A. Miley, Air Technical Service Command, Watson Laboratories; James T. Waber, Illinois Institute of Technology; H. H. Uhlig, Massachusetts Institute of Technology; Michael A. Streicher, Lehigh University; Charles A. Mann, University of Minnesota; A. L. Ferguson, University of Michigan; and W. H. Zinn, Argonne National Laboratory.

The Conference is being sponsored by Carnegie Institute of Technology, Illinois Institute of Technology, Lehigh University, Massachusetts Institute of Technology, Ohio State University, and the Universities of Chicago, Colorado, Minnesota, and Texas. Those interested in the fundamental aspects of corrosion are invited to attend and to participate in the discussion.

Elections

The Southwestern Division, AAAS, at meetings held with the Colorado-Wyoming Academy of Science May 1–3 at Colorado College, elected Frank E. E. Germann executive secretary, and F. H. Douglas president. H. B. Van Valkenburgh was elected president of the Academy.

The Royal Society, London, at a meeting held on May 1, elected the following foreign members: Elie Joseph Cartan, professor of geometry, University of Paris; Paul Karrer, professor of chemistry, University of Zurich, and 1937 Nobel Prize winner; Harold Clayton Urey, professor of chemistry and director of the Institute for Nuclear Studies, University of Chicago, and 1934 Nobel Prize winner; and Øjvind Winge, Carlsberg Laboratory, Copenhagen.

The American Philosophical Society has elected the following officers for the coming year: Thomas S. Gates, president; Ross G. Harrison, Alfred N. Richards, and St. George L. Sioussat, vice-presidents; Ernest M. Patterson and Jacob R. Schramm, secretaries; Francis R. Packard, curator; Joel Stebbins (Class I), Edmund W. Sinnott (Class II), Edwin B. Wilson (Class III), and Howard M. Jones (Class IV), councilors to serve for three years. Residents of the United States elected to membership in Class I (Mathematical and Physical Sciences) include Hans Albrecht Bethe, William Albert Noyes, Jr., George Braxton Pegram, Henry DeWolf Smyth, and Hassler Whitney; Class II (Geological and Biological Sciences), Carl F. Cori, Conrad A. Elvehjem, Hermann J. Muller, William Christopher Stadie, and Edward Chace Tolman; Class III (Social Sciences), Arthur F. Burns, Sydney B. Fay, Walter Lippmann, and Robert Redfield; and Class IV (Humanities), Otto Neugebauer, Reinhold Niebuhr, Paul J. Sachs, and Stith Thompson. Foreign members elected to Class III were Henry Clay, Oxford, England, and Luigi Einaudi, Turin, Italy; to Class IV, Sir William David Ross, Oxford, England; William W. Tarn, Inverness, Scotland; and Lionello Venturi, Rome, Italy.

The Ohio Academy of Science, at its 56th annual meeting, held at Marietta College May 1–3, elected the following officers for the coming year: A. W. Lindsey, Denison University, president; W. M. Tidd, Ohio State University, treasurer; and Rush Elliott, Ohio University, secretary.

The retiring president, H. H. M. Bowman, of the University of Toledo, addressed the meeting on the subject, "Antibiosis." The 1948 meeting of the Academy will be held at the University of Toledo May 6–8.

NRC News

The Committee on Atomic Casualties held its second meeting in Washington, D. C., on May 1. This Committee, which was organized in compliance with a directive issued by President Truman in November 1946, will carry forward a continuing study of the biological and medical effects of atomic radiation on man. Under the Presidential Directive, the NRC, through the Division of Medical Sciences, was authorized to enlist the aid of government agencies and personnel and such civilian agencies and personnel as might be needed to carry out a long-term study of the Japanese casualties. Organizational and financial matters relative to the study were discussed by the Committee at its last meeting, and plans were made to launch investigations at the earliest possible time. Tentative plans call for the establishment of a central office in Washington and one or more field offices in Japan. The first group of investigators will probably be sent to Japan during the summer. The activities of the Committee will be carefully correlated with the responsibilities of the Atomic Energy Commission, which is expected to provide financial support for the Committee's work.

The Committee proposes to undertake studies on keloid formation resulting from exposure to atomic radiation, genetic effects of atomic radiation, the effect of radiation on the physical growth and

development of children, and other clinical and pathological conditions observed since the bombings.

Thomas Rivers is chairman of the Committee, and the following are members: George W. Beadle, Detlev W. Bronk, Austin M. Brues, C. P. Rhoads, Shields Warren, Stafford L. Warren, George H. Whipple, and Raymond E. Zirkle. In addition to the members, medical officers of the Army, Navy, Public Health Service, and Veterans Administration and members of the Division of Medical Sciences are actively participating in the work.

It is noteworthy that the Committee favors the adoption of a liberal policy with respect to the publication of data on the medical and biological effects of atomic radiation and that the Atomic Energy Commission hopes to release as much information as possible on these aspects of radiation.

Recent Deaths

Sir Thomas Henry Holland, 78, retired principal and vice-chancellor, Edinburgh University, and a leading geologist and mineralogist, died May 17. Sir Thomas was formerly director of the Geological Survey of India, professor of geology and mineralogy, Manchester University, and rector, Imperial College of Science and Technology, South Kensington, England.

T. R. Agg, 69, dean emeritus, Division of Engineering, and former director, Engineering Experiment Station, Iowa State College, died May 7 at Mary Greeley Hospital, Ames, Iowa, where he had been confined since March 5.

Edward R. Baldwin, 82, honorary president of Trudeau Sanatorium, Saranac Lake, New York, and a noted authority on tuberculosis, died May 6 at his home at Saranac Lake.

William H. Ross, 71, retired senior chemist, Division of Soil and Fertilizer Investigations, Bureau of Plant Industry, U. S. Department of Agriculture, and assistant editor and abstractor of *Chemical Abstracts* since 1907, died May 16 at Washington Sanitarium, Washington, D. C.

P. A. Taverner, 71, former chief, Division of Ornithology, National Museum of Canada, died May 9 at his home in Ottawa, Canada.

Sir Frederick G. Hopkins, 86, Sir William Dunn professor of biochemistry, Cambridge University, England, died May 16. Sir Frederick, a Nobel Prize winner, was widely known for his vitamin researches.

Milo Hellman, 75, professor of dentistry, Columbia University School of Dental and Oral Surgery, and research associate in physical anthropology, American Museum of Natural History, died May 11 at St. Joseph's Hospital, Far Rockaway, New York, following a cerebral hemorrhage.

G. A. Maney, 58, professor of structural engineering and administrative chairman, Northwestern University School of Engineering, died May 10 at Evanston Hospital, Evanston, Illinois.

Human Relations, a new quarterly journal designed to supplement more specialized journals and to integrate the social sciences, has been organized for publication of comparative studies of the various social sciences at an international level. It will be edited by two committees drawn from the staffs of the Tavistock Institute of Human Relations, London, England, and the Research Center for Group Dynamics, Massachusetts Institute of Technology. The two editorial committees will be assisted by functional advisory editorial boards in Great Britain and North America, whose members represent many different social science disciplines.

Correspondence about policy, contributions, and subscriptions should be addressed to: *Human Relations*, Research Center for Group Dynamics, Massachusetts Institute of Technology, Cambridge 39, Massachusetts.

"**Basic Graphical Symbols for Electric Apparatus,**" a new standard covering symbols used in drawings employed in wide sectors of the electrical field, is now ready for distribution, according to an announcement by P. G. Agnew, vice-president, American Standards Association. The standard, sponsored by the American Institute of Electrical Engineers and the American Society of Mechanical Engineers, supplements one developed in 1944. The symbols covering the power, electrical control, and communications fields, previously available in separate standards, may now be built up from the master symbol code.

Selective lists of technical reports and documents, containing only the most important materials in 13 specialized industrial fields available from the Office of Technical Services, Department of Commerce, have been prepared by the Office. The lists cover the following fields: plastics; vibrators, tampers, pneumatic tools, and drills; jet engines; psychology; infrared; ceramics; magnetic tape machines (magnetophone); adhesives; paper; deterioration; guided missiles; iron ores; and forestry and wood products. Each of the lists cites author, title, price, and reference number of the reports included.

Requests for copies should be addressed to: Reference Service, Office of Technical Services, Department of Commerce, Washington 25, D. C.

The National Registry of Rare Chemicals, Armour Research Foundation, 35 West 33rd Street, Chicago 16, Illinois, indicates that the following chemicals are wanted: trihexylamine, pyrithiamin, naphthazines, ergothioneine, thiolhistidine, kynurenine, dipeptidase, nucleosidase, 2-methoxy-4-ethylphenol, porphyrexide, porphyrindine, indican, carnosine, geranium powder, sumbul, phytic acid, synthaverin, octaverin, quercimeritrin, and m-dimethylaminophenol. Communications regarding these should be sent to the Registry at the above address.

Make Plans for—

Pacific Division, AAAS, 28th annual meeting, June 16–21, San Diego, California.

American Society of Mechanical Engineers, semiannual meeting, June 16–19, Chicago, Illinois.

Meteoritical Society, 10th meeting, June 18–19, San Diego, California.

American Society for Engineering Education, 55th annual meeting, June 18–21, University of Minnesota, Minneapolis.

Guidance Conference on the Measurement of Student Adjustment and Achievement, June 26–27, Ann Arbor, Michigan.

COMMENTS

by Readers

Invitations to the 6th International Congress of Experimental Cytology to be held at Stockholm in 1947 carry the notice that it will not be open to German and Japanese scientists.

Those German and Japanese scientists that may have been accused of criminal actions in the past have been subjected to the legal procedures instituted by the allied nations in the occupied countries. Those that have been found guilty are subject to punishment like any other criminals and it is obvious that such men will not be able to attend the Congress.

We protest that the exclusion of scientists merely on the basis of their nationality is contrary to one of the fundamental tenets of the scientific creed. It belies the very name of the Congress and controverts its aims.

It is hoped that this tragic mistake, so similar to many that were made by scientists after the first world war, will not be allowed to stand. We beg that the restriction be lifted at once. (TH. DOBZHANSKY, SELIG HECHT, FRANZ SCHRADER, and G. G. SIMPSON, *Columbia University.*)

The holding of international conferences this year has agitated the question regarding the participation of scientists from the former Axis countries, particularly Germany. Scientists in the past generally have been able to remain aloof from the psychology of enmity and war. A change came with Hitlerism. Today, our hesitation at accepting Germans to our conferences emanates not from the effects of actual combat but from the deeds which were performed by the German Government for years before the war and which attained their vilest proportions during the war. Every German who survived without protest against the regime he lived under must accept responsibility, be it of a lesser or greater degree, for the terrible fact that our present-day civilization has witnessed the official enactment of bestiality in a country we had learned to respect as enlightened.

I understand that some Germans are being invited to attend the conferences, the selection being limited to those who underwent physical suffering because of the stand they took against Naziism. Doubtless many endured mental suffering. We are sorry for them. We regret that there must be some who suffered persecution but, because of physical limitations of the several committees, are not on invited lists. We trust that, in time, the elimination of the perpetrators of Naziism and the delusions of the Nazi doctrine will gradually bring the German people back to a state of mind which will permit them to be respected again by the rest of the world.

Anyone approving of the decision taken by the International Congress of Experimental Cytology being held in Stockholm this summer, is invited to send a letter of confidence to the Congress for the stand which it has taken. (ROBERT CHAMBERS, *New York University.*)

In the issue of April 4 Sally Hughes-Schrader protests against the exclusion of "German and Japanese *colleagues*" from international scientific congresses "on such *nonscientific ground* as nationality" (italics mine). . . .No *international* congress should admit the subjects of a nation that discriminated against the Nobel Prize, the highest known international award, because of its international character; of a nation that denies Hughes-Schrader's sentence that "science transcends considerations of nationality, as of race, color, and creed." No *scientific* congress should admit the subjects of a nation that falsified scientific facts, and called murder scientific investigation . . . if German or Japanese subjects beg to be admitted to international meetings, may they be given the opportunity to prove that they disapprove *in public* of the Nazi behavior, and those who did so will be welcomed as men and scientists. The participation of other German or Japanese individuals will do good neither to science nor to humanity. (F. L. HAHN, *Apart. Post. 9622, Mexico, D. F.*)

The processes of evolution have required very long periods of time. A renewed impression of their near infinitude has been received from reading a discussion of the dispersal of faunas over land bridges. Those bridges were available during only fractions of evolutionary time and certainly were ecologically restricted in contrast to the continents connected. As animals cannot migrate for long distances over territory lacking their ecological requirements, the land bridges cannot be regarded as having been highways suitable for all to travel throughout their existence.

Another great retarding factor, which apparently has not been taken into consideration, is the highly sedentary nature of animal populations. As a rule, they remain on the ancestral range. The movements of individuals are limited, many passing their entire lives in an area of a few acres or less. With attachment to the home range so dominant, it is evident that animal populations, as a whole, could not move, or even be forced to move, at more than a glacial rate. Eons, no less, would be required for far-flung migrations of fauna.

True, there is also a dispersive factor; barriers permitting, animals do extend their ranges. But along with revelation by modern studies of the essential stability of populations, it has also been shown that animals leaving the home range suffer very high mortality. The young, among which centrifugal wandering is often evident, suffer a high proportion of the entire mortality of their species. Although some of them succeed in establishing themselves, usually in vacancies in the hereditary domain, this occurrence does not controvert the impression that the occupation of new territory is normally a very gradual process and, therefore, that extensive transfer of faunas by land bridges must have been an infinitely slow process. (W. L. MCATEE, *5750 Ellis Avenue, Chicago, Illinois.*)

TECHNICAL PAPERS

Variations in the Normal Electroencephalogram During a Five-Year Period

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In the course of a variety of experimental studies during the past five years numerous electroencephalograms were obtained on three individuals who served as subjects. During this time these subjects were exposed to high altitude, decompression sickness, vasodepressor syncope, abdominal distension, anoxia, hypoglycemia, acapnia, fatigue, alkalosis from ingestion of large quantities of sodium bicarbonate, alcohol, and toxic doses of atabrin. Reversible changes were produced by many of these procedures. Two subjects during this period had several episodes of migraine with scintillating scotomata, during which focal slowing in the occipital region occurred. A large number of control records were obtained before and after recovery from these experiences. This mass of data on three individuals offers a good opportunity to study the variability of the electroencephalogram in the same individual over a five-year span.

METHODS

A Grass three-channel electroencephalograph was used, and bipolar fronto-occipital tracings were obtained. Five to 10 minutes of record were obtained on each occasion. The records were analyzed by the technique already described in earlier publications (*2*), a frequency spectrum and mean frequency being derived for each record.

The subjects were all males, aged 29, 33, and 36, respectively, at the time of the first observations. The level of sugar in antecubital vein blood was measured at the time of each electroencephalogram, and in about one-third of the experiments rectal temperature was also recorded.

RESULTS

There was no change in the gross appearance of the control electroencephalograms of any individual during the five-year period. No variation in regularity and no unusual wave forms or frequencies appeared. The amount of uncountable low-voltage fast activity ranged between 0 and 5 per cent. The changes produced by the experimental procedures noted above and during the scotomata of migraine were apparently completely reversible.

The spread of mean frequencies over the five-year period for each individual was as follows (Fig. 1): Subject A, 8.8–9.6 cycles/second (39 observations); Subject B, 8.3–9.3 cycles/second (32 observations); Subject C, 8.8–9.3 cycles/second (25 observations). Subject B showed some suggestion of an increase in frequency with successive years, but such a trend was not apparent in the records of the other subjects.

Blood sugar values varied as follows: A, 80–119 mg./100 cc.; B, 80–137 mg./100 cc.; C, 75–126 mg./100 cc. There was no consistent correlation between the daily fluctuations in mean frequency and in blood sugars.

Rectal temperatures ranged from 98° to 99.8° F. among the three subjects at different times, and there was no correlation between body temperatures and the small daily fluctuations in mean frequency.

DISCUSSION

These results indicate that at least among three normal males in the fourth decade with very regular EEG's there

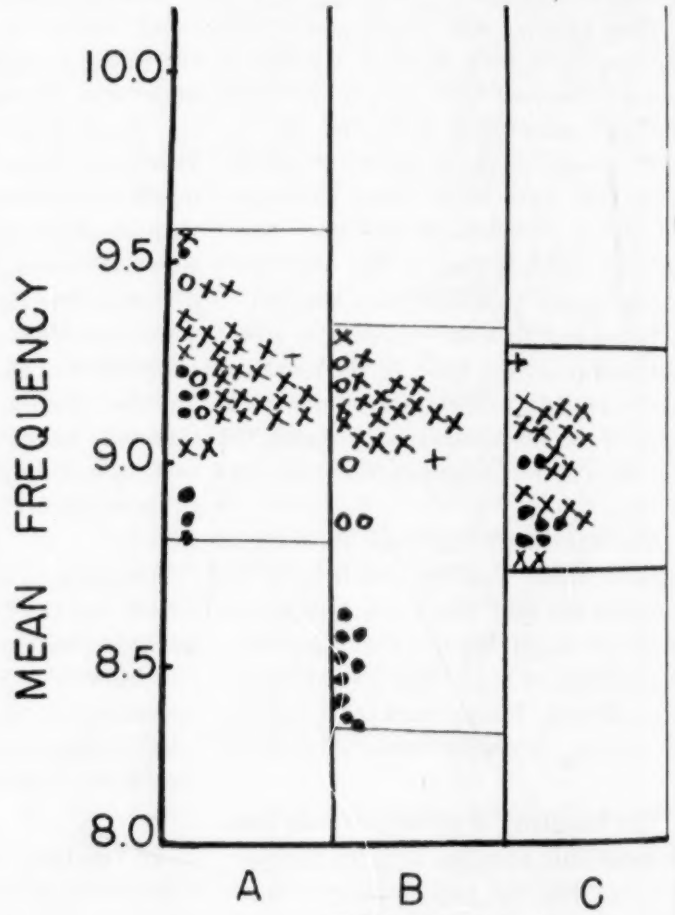

FIG. 1. 1942–●; 1943–○; 1944–×; 1946–+.

was remarkably little change in mean frequency over a five-year period. We hesitate to attach any significance to the apparent slight increase in frequency in one subject. These findings are particularly noteworthy when one considers the variety of experimental conditions affecting the electroencephalogram to which these individuals were subjected.

The stability of the EEG for the same individual is well known, but few quantitative and long-term observations are available. Davis and Davis (*1*) recorded EEG's of a number of subjects over four years and found no change in the gross appearance of the records. Loomis, Harvey, and Hobart (*4*) found the range of 16 mean alpha-frequency determinations in one subject over an eight-month period to be about 1

cycle. Jasper and Andrews (*3*) report a variation of only 1–2 per cent between measurements made on six normal individuals over a period of 6–18 months. Rubin (*5*), whose method of calculating mean alpha frequency corresponds closely to ours, found a variation of less than 1 cycle/second in the mean alpha frequency of a number of normal subjects and schizophrenics observed over periods up to four months. Thus, our results confirm and extend earlier observations.

The failure to find any correlation between the mean frequency and blood sugar level is of some interest, since we had previously reported variations in mean frequency with changes in blood sugar (*2*). However, in those studies the change was produced by the intravenous injection of sugar or insulin and was rapid. Evidently, at any given frequency level rapid changes in blood sugar will produce shifts in frequency, but the day-to-day variations in mean frequency must be accounted for on some other, as yet unknown, basis. This does not appear to be body temperature.

These results also give some indication of the reliability of this method of frequency analysis of the electroencephalogram. For clinical purposes, changes in mean frequency of greater than 1 cycle/second may be considered significant.

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Ordovician Chazyan Classification in Vermont

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Middle Ordovician limestones of west-central Vermont have been described and mapped by Cady (*1*), who included the Crown Point, Beldens, and Middlebury formations in the Chazy "group." Inasmuch as the first-named formation is structurally separated from the Crown Point limestone of the type locality and other outcrops in New York and is succeeded by the Beldens formation rather than by the Valcour limestone, it is proposed that the "Crown Point" formation east of the Champlain thrust in west-central Vermont be designated the Burchards limestone, named from a stream that enters the Lemon Fair River three miles west of the type locality in the belt of outcrop between Cornwall village and The Ledges, Addison County; the formation consists of about 150 feet of somewhat magnesian limestone that has a species of *Maclurites*. The Burchards and succeeding Beldens limestones and dolomites comprise a lithologic sequence that contrasts with the succeeding thinner-bedded Middlebury limestone. This sequence of Burchards and Beldens is designated the Chipman group from Chipman Hill, which lies in the belt of outcrop north of Middlebury village.

The "Chazy" rocks of northern Lake Champlain have been studied by Kay, who has described the Carman quartzite and Youngman formation of northwestern Vermont and southeastern Quebec as succeeding the Beldens in the Highgate Springs slice (*3*). The type Carman consists of about 120 feet of quartz sandstone. The Youngman, more than 300 feet of argillaceous, thin-bedded limestone grading up into dark slate having dense limestone lenses, has *Lonchodomas halli* (Billings) persisting, *Christiania* sp. common in basal beds, *Maclurites* sp. present higher, and *Rostricellula* sp. near the top; the section is somewhat incomplete in the type exposure because of a thrust fault. Kay believes it probable that the Carman quartzite is essentially equivalent to the quartzite in the lower Day Point formation that, with the succeeding Crown Point and Valcour, is the Chazy sequence in New York. It is proposed that the Carman and Youngman formations comprise the Maquam group, named from Maquam Bay, six miles south of the type sections at Highgate Springs, Vermont.

Inasmuch as all these sequences have been called Chazy for nearly a century or longer, it is recommended that the Chazyan series consist of the Chipman and Maquam groups, as well as the Chazy limestones of eastern New York. This use of Chazy is considered to have priority over the Chazyan of Grabau, which added the Black River group (*2*), and of Ulrich, which was for a composite of widely scattered stratigraphic units (*4*).

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A Study of the Inner Bark and Cambial Zone of Black Spruce (*Picea mariana* B.S.P.)[1]

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The inner bark and cambial zone of a tree contain living cells that are active in its life processes and growth. These cells take part in the conversion of sugars and other compounds, synthesized elsewhere, into wood and bark. A study of the composition of the living areas of the tree should help greatly in understanding the genesis of materials present in mature woods. Hitherto, relatively few investigations of this type have been undertaken, and, to the best of our knowledge, these have been limited to European woods (*1*). With this in mind, a study of the inner bark and cambial zones of freshly cut trees was begun during the summer of 1946.

Six layers were separated from a black spruce log, approximately 65 years old, which was cut on June 3, 1946. These layers were: (1) the outer bark, (2) the inner bark, (3) the cambial zone, (4) the young sapwood, (5) the sapwood, and

[1] This investigation was suggested by Harry F. Lewis, of The Institute of Paper Chemistry. Acknowledgment is also made to the following staff members of the Institute: I. H. Isenberg, M. A. Buchanan, L. E. Wise, and P. F. Cundy. The authors express their appreciation to Robert Buxton and Mrs. Evelyn K. Ratliff, who made many chemical analyses of products isolated during the investigation.

(6) the heartwood. The cambial zone occurs as a slightly viscous layer on the inner surface of the bark and on the outer surface of the freshly peeled log.

After analysis of small samples of these layers, the results of which are shown in Table 1, larger portions were extracted

TABLE 1

ANALYSES OF FRACTIONS OF BLACK SPRUCE

(On the oven-dry basis)

	Outer bark	Inner bark	Cambial zone	Young sapwood	Sapwood	Heartwood
Ash, %	1.20	3.18	3.57	0.37	0.30	0.28
Nitrogen (Kjeldahl), %	0.32	0.60	1.09	0.26	0.05	0.06
"Protein" (N × 6.4), %	2.05	3.84	7.06	1.66	0.32	0.38
Pentosans, %	11.80	12.03	6.30	8.12	12.05	12.45
Uronic anhydride (CO_2 × 4), %	8.56	10.00	4.60	3.80	3.72	3.92
Lignin (Klason method) in:						
Unextracted material, %	33.9	6.6	1.83	24.9	26.3	26.1
Extractive-free material, %		9.00	6.03			
Methoxyl, %	4.00	2.19	0.72	4.73	4.89	4.75
Tannin (A.O.A.C. method), %	1.9	7.6	Neg.	Neg.	Neg.	Neg.
Starch test (iodine color)	Neg.	Pos.	Neg.	Neg.	Neg.	Neg.

with hot benzene, alcohol, and water. The inner bark was converted into holocellulose (*4*), which was successively extracted with a 3 per cent solution of ammonium hydroxide and a 5 per cent solution of potassium hydroxide. The various extracts have been analyzed. Although the work is far from complete, a brief report can now be made of the preliminary conclusions that were reached, and certain suggestive hypotheses may be formulated.

The percentages of "protein" (calculated from Kjeldahl nitrogen) vary in the different layers from 0.3 in the mature wood through 1.65 in the very young sapwood and from 3.85 in the inner bark to 7 in the cambial zone. Although the layers were not separated completely, the higher percentages of "protein" in the inner bark and cambial zone presumably are due to the living material in these layers which contains the protoplasm of the tree. The amount of "protein" in the alcohol-insoluble part of the cambial zone was 19.2 per cent.

Crystalline sucrose to the extent of 33 per cent (on a dry basis) was obtained from the cambial zone. Sucrose was also found in considerable amount in the inner bark. Large amounts of alcohol-soluble sugar sirups from these two zones are yet to be studied.

The cambial zone was low in pentosans, lignin, and methoxyl. These materials are not characteristic of very young tissues but are often found in large amounts in older tissues. They were present in large amounts in the outer bark, sapwood, and heartwood. Possibly they originate in the cambial zone as metabolic products which are then laid down permanently in mature wood. Tannin was found only in the outer and inner bark of this wood.

The benzene extract of both the inner bark and the cambial zone contained a white solid, which may possibly be a glycoside, and a yellowish oil. The solid, which was difficult to separate from starch, did not dissolve in the benzene but was present in finely divided form in the solvent. It amounted to 0.5 per cent of the inner bark. This material gives intense colors with alkali and with methanolic HCl. The oil, which amounted to approximately 4 per cent of the inner bark, probably is similar to the material isolated by Wise and Moore (*3*) from black spruce wood. Fatty materials are known to originate during metabolism of sugars; it is possible that extractives, such as those reported by Wise and Moore, are formed in the living zone and transported later to the wood.

Pectic materials occur in rather large amounts in the inner bark of black spruce, where they are mixed with starch. These were isolated by successive extraction with hot water, very dilute hydrochloric acid, and 3 per cent ammonium hydroxide, and by precipitation as insoluble calcium pectate. They were also isolated from the holocellulose of the inner bark. An insoluble calcium pectate that gave 63.0 per cent uronic anhydride (as measured by evolution of CO_2) was isolated and converted to a pectic acid giving 75.4 per cent uronic anhydride. Because of their presence in greatest amounts in young tissues, it is probable that these materials are laid down during the early stages of cell-wall formation in wood.

Hemicelluloses were isolated by successively extracting the holocellulose of the inner bark with 5 per cent solutions of ammonium hydroxide and potassium hydroxide. For comparison, a hemicellulose was isolated by extracting the holocellulose of sapwood with 5 per cent potassium hydroxide. The chief difference noted between that from the inner bark and that from the sapwood is a much smaller percentage of methoxyl and pentosans in the former than in the latter. This suggests that the hemicelluloses in the inner bark are in the process of formation, whereas those in the sapwood are fully formed. In general, hemicelluloses in mature wood contain one ether-linked methoxyl group for each uronic acid group (*2*). Those from the living part of the tree, such as the inner bark, appear to have less than one methoxyl for each uronic acid group. It is possible that, as methoxyl groups are produced in the metabolic processes of the living zone, they are removed from the system by combination with uronic acids. In this connection it has been found that Klason lignin from the bark has a lower methoxyl content than that from mature wood.

This difference would be explicable if, in fully matured lignin, methoxyl groups were fixed by the lignin molecule in addition to that fixed by polyuronide. In this case, lignin from the bark may not be fully methylated. In the present investigation, Klason lignin from the inner bark contained 7.5 per cent methoxyl, whereas lignin from the sapwood contained 14.9 per cent. On the other hand, an analysis of the Klason lignin from the inner bark revealed that it was very intimately mixed with other (largely nitrogen-containing) materials that have no methoxyl groups. The presence of protein degradation products in the lignin would also account for the lower percentage of methoxyl found.

The study of the composition of the living part of wood is being continued as rapidly as possible both at The Institute of Paper Chemistry and at the University of Arizona.

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IN THE LABORATORY

The Quantitative Chromatography of Silk Hydrolysate

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Partition chromatography has become an important tool in the analysis of proteins. Especially as carried out on strips of filter paper according to the techniques of Consden, Gordon, and Martin (*2*), it has provided an extraordinarily rapid and sensitive way of recognizing the numerous amino acids in an hydrolysate of a protein. We have found that under proper conditions it can also provide quantitative information about the amounts of these amino acids.

As is well known, this chromatographic analysis proceeds by allowing a small volume of hydrolysate on filter paper to be leached out by a solvent saturated with water while the paper is hung up in an atmosphere saturated with vapors of this solvent and water. Under these conditions, the rates of flow of the acids present are often so different that after two or three days all of a component will be localized in a band or spot on the paper. Those acids that migrate at about the same rate in one pair of solvents can often be separated in another; or the paper can, after the first separation, be turned through 90° and the separation continued with another solvent. Since the rates of migration on an inert substrate such as paper are primarily determined by partition coefficients between the solvents used, a knowledge of these coefficients permits recognition of the acids in the bands or spots of the finished chromatogram.

Valid quantitative results can be obtained from such an analysis only if it is carried out under controlled conditions which allow comparison with a simultaneously prepared chromatogram of a known mixture of amino acids and if it involves bands well separated from one another. To obtain these, several runs, using different solvents, may be required.

There are several ways of determining the amount of amino acid in a band. It can be done by extracting the acid and making a micro-Kjeldahl determination of the extracted nitrogen. Filter paper with which we have worked has contained amounts of nitrogen comparable with that in the extracted acid, and colorimetric procedures have proved more convenient and accurate. In the techniques as finally adopted, chromatograms of the hydrolysate and of the standard mixture of acids were always prepared at the same time in the same jar. At the conclusion of the run the two were dried together without resort to heating, and color was developed by spraying the papers with ninhydrin (0.1 per cent in butanol) and heating to 90° C. for 5 minutes, using the entire paper or vertical stips cut from it to provide a guide to the positions of the bands. If entire sheets were colored, the corresponding band on the unknown and the control were cut out, their colors extracted (preferably with acetone), and the extracts made up to known volume, diluted, and compared in a colorimeter. These steps were always carried out promptly and under the same conditions for unknown and control. When the bands were sufficiently separated on the finished chromatogram so that the amino acid-containing areas of the filter paper could be identified by reference to a strip cut from its edge and colored with ninhydrin, the amino acids themselves were often leached from the paper before treatment with ninhydrin. Satisfactory results have also been obtained by applying the hydrolysate in a series of dilutions as drops and by setting up composite standards in which the known amino acid mixture was also applied at a series of dilutions. In this case, color was developed on the papers, and the amount of an amino acid in the unknown was determined by finding spots of equal intensity and area on the standard and unknown papers. This "spot-dilution" technique is especially promising.

Though knowledge of partition coefficients is often sufficient to identify the amino acids present on a chromatogram, a more direct means is frequently desirable. Electron diffraction has proved particularly useful for this purpose. If sufficient care is taken in making the preparations, excellent diffraction patterns can be obtained (*3*) with an RCA type EMU electron microscope from very few micrograms of amino acid extracted from a spot or band—and the identification this provides is unequivocal. Such diffraction observations have identified traces too small for quantitative determination and have proved useful as indices of purity of the extract from a band.

TABLE 1

THE AMINO ACIDS OF SILK

Amino acid	HCl hydrolysate of silk		Artificial mixture		Previous analyses	
	Color analysis	Spot dilution	Composition	Estimated spot dilution	(a) (*1*)	(b) (*4*)
Arginine	2.4	0.8			0.76	0.7
Glycine	39.9	42.4	43.4	39.0	43.8	40.5
Serine	12.7	11.9	1.9	3.2	13.6	1.8
Alanine	37.6	34.0	26.8	29.6	26.4	25.0
Proline	trace	trace	1.1	—	1.0	1.0
Valine	4.4	5.7			—	—
Isoleucine	trace	2.5	2.7	3.8	2.5	2.5
Phenylalanine	absent	absent	12.3	12.5	1.5	11.5
Tyrosine	5.9	8.3	11.8	14.6	13.2	11.0
Methionine	absent	absent			2.6	—
Histidine	—	—			0.1	0.1
Threonine	—	—			1.4	—
Total	102.9	105.6	100.0	102.7	106.9	94.1

This work has been carried out in the search for methods applicable to the analysis of purified viruses. To determine

the accuracy of the foregoing and other procedures tested, however, we have made many analyses of silk, chosen because of its relative simplicity and the detail with which it has been studied by classical methods of analysis. The data in Table 1 illustrate the kind of accuracy furnished by these chromatographic procedures.

The results of columns 2 and 3 are single readings of representative chromatograms. For column 2 the acids were extracted from the paper after treatment with ninhydrin and measured colorimetrically; for column 3 the procedure was that described above as the spot-dilution technique. A comparison between columns 4 and 5 indicates the kind of agreement to be expected between duplicate runs. Previous analyses are reproduced in columns 6 and 7.

There are several significant differences between our results and the earlier ones. We agree with analysis (a) and disagree with analysis (b) in finding a high serine content and little, if any, phenylalanine. According to chromatographic analysis, there is less tyrosine and more alanine than was found by earlier methods. Valine was not previously identified; on the other hand, there has been no chromatographic evidence for methionine. The solvents used in this work were not appropriate for determinations of the other two acids, histidine and threonine, that have been reported.

The methods used and results obtained in this study will be described in detail elsewhere.

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Illuminator for Melting-Point Blocks

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Berl and Kullman (*2*) and Bergstrom (*1*) have described copper melting-point blocks which give more accurate results than the open beaker type of apparatus. However, the copper block is only as accurate as the amount of illumination supplied to its interior. Most investigators have used quartz rods to conduct the light to the interior. Although this gives a good source of light, the rods are expensive and subject to breakage. To overcome these disadvantages, the illuminator described below was constructed.

A piece of aluminum alloy tubing, $\frac{7}{16}$ inch in diameter, was bent to form a circle 10 inches in diameter. A piece of sheet aluminum alloy $\frac{1}{16}$ x $1\frac{1}{4}$ x 10 inches was bolted to this circle and trimmed so that the outside edge was 9 inches long and its center was $2\frac{7}{8}$ inches from the center of the block. Two cones were constructed from sheet copper. One end had a diameter of $\frac{15}{16}$ inch, and the other tapered to $\frac{5}{16}$ inch. Two brass light fixtures, each holding a 7-watt lamp, were mounted in these cones and then bolted to the aluminum ring. Wires from the lamps passed through the ring and out at the rear, where they were attached to a female plug (Fig. 1).

The illuminator was connected to the block by glass rods, $\frac{5}{16}$ inch in diameter, cut to fit the block used. The entire apparatus usually is mounted by clamping it to a ring stand. The addition of a magnifying glass or telescopic sight mounted

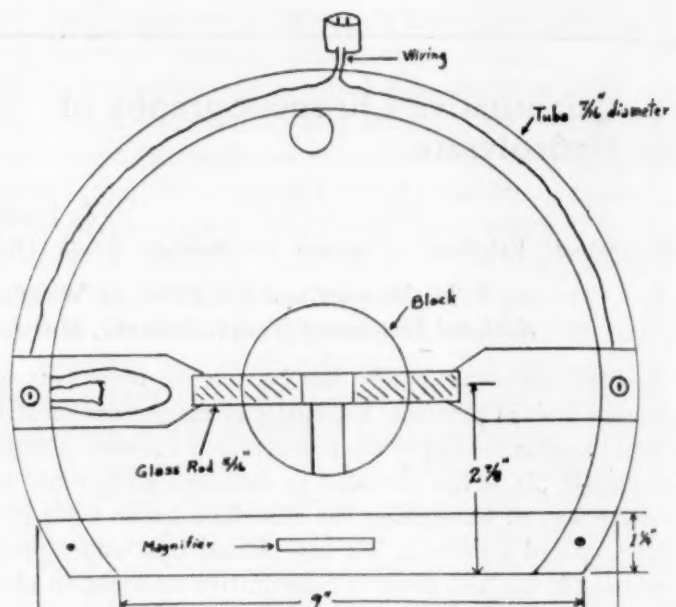

Fig. 1

in the center of the cross brace and sighted on the observation hole in the block completes the apparatus.

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Interference by ATP in the Estimation of Coenzyme I

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Chemical and physicochemical methods cannot be relied upon for the estimation of coenzyme I in tissue extracts; biochemical methods involving the use of enzyme systems are the most advantageous. Among these, the most widely used has been the fermentation method of von Euler and Myrbäck (*4*), where apozymase is used as the source of enzymes and the coenzyme is estimated by the volume of carbon dioxide liberated when excess sugar is fermented in the presence of inorganic phosphate and hexose diphosphate. In the method due to Warburg (*6*), partially purified enzymes, protein A and protein B, obtained from Lebedev's juice, are used, the other components of the system being coenzyme I, adenine nucleotide, Robison ester, acetaldehyde, phosphates and magnesium, manganese and ammonium ions. Jandorf, Klemperer, and Hastings (*2*) described a new method based on the catalysis by coenzyme I of the breakdown of hexose diphosphate in the presence of arsenate, a dialysed aqueous extract of cat muscle being used as the source of glycolytic enzymes. Haas (*1*) has suggested

[1] Government of India scholar. The author is grateful to J. B. Sumner for his interest in this investigation and to the Rockefeller Foundation for financial support.

that coenzyme I may be estimated spectrophotometrically by the reduction of 2,6-dichlorophenolindophenol by dihydrocoenzyme formed in the presence of suitable substrate and apodehydrogenase. Very recently (*3, 5*) two other methods have been reported from this laboratory.[2] In one, use is made of lactic

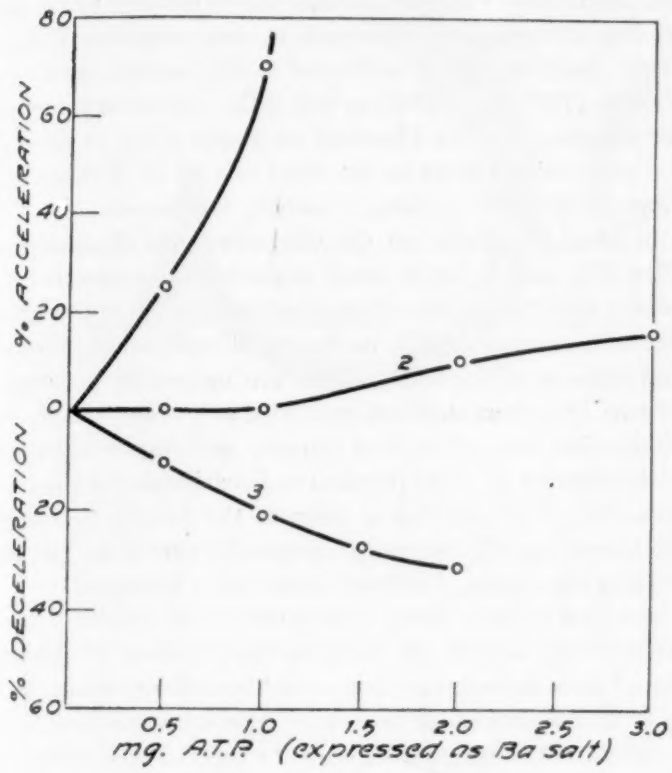

FIG. 1. Method of von Euler and Myrbäck, 1; method of Krishnan, 2; method of Jandorf, *et al.*, 3.

apodehydrogenase and diaphorase in the test system, and in the other, aetiozymase is used as the source of aldolase and triose phosphate dehydrogenase. While all these methods give satisfactory results with comparatively pure solutions of coenzyme I, no unequivocal proof has yet been furnished as to their applicability to tissue extracts, where interfering substances might be present.

The present report deals with one such possible interfering substance, namely, ATP, which is present in certain tissues in concentrations several fold that of coenzyme I. We have worked with three different test systems: the fermentation method of von Euler and Myrbäck, the manometric method of Jandorf, *et al.*, and the oxygen-absorption method of Krishnan (*3*). The concentrations of ATP, expressed in terms of the original dibarium salt, ranged from 0.1 to 3 mg./reaction flask, and that of coenzyme I, from 8 to 16 γ. The results obtained are represented in Fig. 1.

It is apparent that very small amounts of ATP (of the order of 0.1 mg.) have practically no effect on results given by the methods mentioned above. This is in agreement with the statement by Jandorf, *et al.*, who found that ATP is without influence on the course of the reaction developed by them. However, when the concentration is increased, it exerts a pronounced effect on the rate of the reaction. In the fermentation method of von Euler and Myrbäck (where readings were taken of the maximum rate of fermentation in a 10-minute interval, as recommended by Axelrod and Elvehjem) and in the oxygen-absorption method of Krishnan, the reaction rate is accelerated, whereas in the method of Jandorf, *et al.* the effect is of an inhibitory nature. It may also be noted that the interfering effect of ATP is least in the oxygen-absorption method. This is to be expected, since ATP is not known to influence the stages of glycolysis used in the test system. ATP exerts its maximum effect on the fermentation method utilizing apozymase[3]—an effect different from that of hexose diphosphate, which is believed to function merely by decreasing the induction period.

The conclusion has to be drawn, therefore, that in such tissue extracts and test systems, where there is a preponderance of ATP over coenzyme I, appreciable errors will be introduced in the estimation of the latter by the conventional biochemical methods.

[2] Details of these methods will be published elsewhere.

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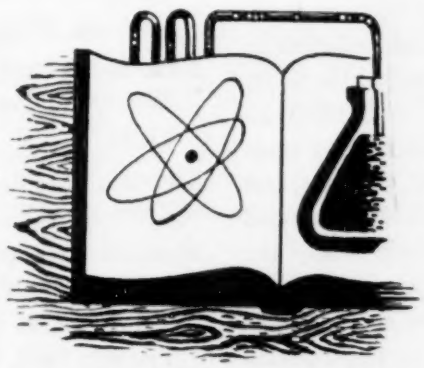
[3] Apozymase was prepared by drying brewer's bottom yeast (obtained from Haberle Congress Brewing Company, Syracuse) for 24 hours at room temperature and washing 5 times with large volumes of distilled water. The specimen of ATP used in the above experiments was supplied by I. C. Gunsalus, to whom our grateful thanks are due.



Book Reviews

The collected papers of C. S. Hudson. (Vol. I.) Raymond M. Hann and Nelson K. Richtmeyer. (Eds.) New York: Academic Press, 1946. Pp. xxxv + 898. (Illustrated.) $15.00.

To celebrate the occasion of the 65th birthday of C. S. Hudson, the Division of Sugar Chemistry and Technology of the American Chemical Society undertook the publication of these "Collected Papers" in recognition of Dr. Hudson's contributions to the chemical literature during more than four decades.

Volume I comprises 118 papers from a total of 247. The papers are placed in groups arranged according to subjects. No changes have been made in the original texts except where minor errors have been encountered. The titles of the sections follow: (I) The Forms of Milk Sugar. Physical Chemistry of Solutions. Mutarotation of Sugars. (II) Enzymes: Studies of Invertase, Amylases, and Emulsin. (III) Preparation of Sugars. (IV) Rules of Isorotation. Acetyl Derivatures of Sugars and Glycosides. (V) Lactone, Phenylhydrazide, Amide and Benzimidazole Rules.

The papers of this brilliant scientist, collected as they are here, will be indispensable to those who follow the sugar field closely. Much of the fundamental work on sugars which led to a clarification of their characteristics and their structures is found in them.

Of no minor interest is Dr. Hudson's autobiography, which is included. It is a permanent record of the life of the leading sugar chemist in the United States and one who has done much for the prestige of American science.

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X-ray diffraction studies in biology and medicine. Mona Spiegel-Adolf and George C. Henny. New York: Grune and Stratton, 1947. Pp. viii + 215. (Illustrated.) $5.50.

In the preface the authors present this book as the first "comprehensive survey on x-ray diffraction in biology and medicine in the English language." As such it is welcomed and should serve a purpose. They have also taken "the opportunity to review [their] own diversified studies in this field during the last ten years and to present them in the framework of the pertaining literature against a broader background. Since this presentation is made for the use of the biologist and research physician, purely physical and mathematical discussions have been omitted wherever it was possible to do so without sacrificing accuracy." It is in these aims and their embodiment in the text that one finds limitations to the usefulness of the book.

The physician or biologist will be prepared neither to read critically nor to conduct research reliably in the field by mastering the introductory three chapters on theory, practice, and pattern interpretation, without recourse to much wider perusal of the references cited. By avoiding or sketching briefly the more technical phases of the physics, mathematics, and crystallography of x-ray diffraction investigation, the authors have failed to furnish adequate background for even an appreciation of the scope and significance of the contributions which x-ray diffraction has and can make to biological sciences.

Chapters IV through XII summarize special aspects of diffraction studies, covering applications to carbohydrates, amino acids and derivatives, proteins, nucleic acids and nucleoproteins, muscle, lipids, nerves, steroids, and finally, bones, teeth, and concretions. Perhaps the most useful features of the book are the bibliographies at the ends of these chapters. Unfortunately, each list cannot be trusted to be complete, even up to the date (1945, some 1946) at which the references terminate. For example, work at Pasadena on amino acids, at Ames on amylose, and the more recent views of Cox on pyranose ring structure are either missing or scarcely mentioned.

In all of the discussion the vital structural significance of diffraction data is pretty much neglected. Measurement of a spacing has little but identificational importance, without relation to its crystallographic or structural implication. Often the final steps of diffraction analysis are impossible in complex systems, but where they can be carried out, even partially, the information thus gained is of primary importance and should not be slighted to avoid physical and mathematical complications. Only brief mention is given to the Fourier projections which are so rapidly becoming an essential part of the language in which the results of diffraction study are expressed.

The book is attractively bound, printed on excellent paper, and profusely illustrated. Many of the reproduced "diffractograms" seem unnecessary, however. About 60 per cent of them are of diffuse unoriented or powder type, corresponding to the unwarrantedly large proportion of the text devoted to the simpler but also less significant facts that can be deduced from diffraction-poor diagrams.

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Scientific Book Register

CLARK, HUBERT LYMAN. ***The echinoderm fauna of Australia; its composition and its origin.*** (Publ. 566.) Washington, D. C.: Carnegie Institution of Washington, 1947. Pp. iv + 567. $4.00, paper; $4.50, cloth.

LEIGHTON, DOROTHEA, and KLUCKHOHN, CLYDE. *The Navaho individual and his development.* Cambridge, Mass.: Harvard Univ. Press; London, Engl.: Oxford Univ. Press, 1947. Pp. xi + 277. (Illustrated.) $4.50.

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NATHAN, DAVID S., and HELMER, OLAF. *Analytic geometry.* New York: Prentice-Hall, 1947. Pp. x + 402. (Illustrated.) $3.50.

THOMAS, ISLYN. *Injection molding of plastics.* New York: Reinhold, 1947. Pp. viii + 534. (Illustrated.) $10.00.

WISELOGLE, FREDERICK Y. (Ed.) *A survey of antimalarial drugs, 1941–1945.* Ann Arbor, Mich.: J. W. Edwards, 1946. Vol. I: Pp. xi + 536; Vol. II, Pt. 1: Pp. 987; Vol. II, Pt. 2: Pp. 988–1921. $30.00.